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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

518-1012

**TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371**

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5)

09/673002

INTERNATIONAL APPLICATION NO

PCT/FR99/00835

INTERNATIONAL FILING DATE

April 9, 1999

PRIORITY DATE CLAIMED

April 10, 1998

TITLE OF INVENTION

Method For Fine Synchronization On A Signal Received From A Transmission Channel

APPLICANT(S) FOR DO/EO/US

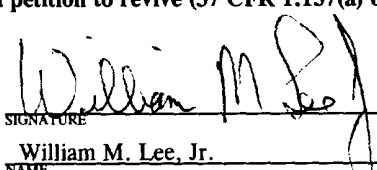
Jean-Louis Dornstetter and Nidham Ben Rached

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 37 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

**Items 11. to 16. below concern other document(s) or information included:**

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A **FIRST** preliminary amendment.  
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☐ Other items or information:

U.S. APPLICATION NO. (If known, see 37 CFR 1.50) <b>09/673002</b>		INTERNATIONAL APPLICATION NO. PCT/FR99/00835		ATTORNEY'S DOCKET NUMBER 518-1012	
17. <input checked="" type="checkbox"/> The following fees are submitted:  <b>Basic National Fee</b> 37 CFR 1.492(a)(1)-(5): Search Report has been prepared by the EPO or JPO ..... \$840.00  International preliminary examination fee paid to USPTO (37 CFR 1.482) . \$670.00  No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$760.00  Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$970.00  International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) ..... \$96.00				CALCULATIONS	PTO USE ONLY
<b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>				\$860	
Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <u>  20  </u> <u>  30  </u> months from the earliest claimed priority date (37 CFR 1.492(e)).					
Claims	Number Filed	Number Extra	Rate		
Total Claims	10 - 20 =	0	X \$18.00	0	
Independent Claims	1 - 3 =	0	X \$78.00	0	
Multiple dependent claim(s) (if applicable)			+ \$260.00	270	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				1130	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).					
<b>SUBTOTAL =</b>				1130	
Processing fee of <b>\$130.00</b> for furnishing the English translation later than <u>  20  </u> <u>  30  </u> months from the earliest claimed priority date (37 CFR 1.492(f)).					
<b>TOTAL NATIONAL FEE =</b>				1130	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property +					
<b>TOTAL FEES ENCLOSED =</b>				1130	
				Amount to be refunded:	
				Charged	
a. <input checked="" type="checkbox"/> A check in the amount of \$ <u>1130</u> to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. <u>12-0913</u> in the amount of \$ <u>      </u> to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>12-0913</u> . A duplicate copy of this sheet is enclosed.					
<b>NOTE:</b> Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
<b>SEND ALL CORRESPONDENCE TO:</b> William M. Lee, Jr. Lee, Mann, Smith, McWilliams, Sweeney & Ohlson P.O. Box 2786 Chicago, Illinois 60690-2786 (312) 368-1300					
				 SIGNATURE William M. Lee, Jr. NAME 26,935 REGISTRATION NUMBER	

METHOD OF FINE SYNCHRONIZATION TO A SIGNAL RECEIVED FROM  
A TRANSMISSION CHANNEL

The present invention relates to a method of fine  
synchronization to a receive signal corresponding to a  
5 reference signal transmitted in a transmission channel

In a transmission system, in particular a radio  
transmission system, a transmitter transmits a reference  
signal to a receiver in a transmission channel. One of  
the first operations that the receiver must perform is to  
10 synchronize to the receive signal. This problem is well-  
known to the skilled person and it is therefore  
unnecessary to remind the reader here of the various  
techniques that have been used to obtain such  
synchronization.

15 If the signals are digital signals, it is usual to  
evaluate the synchronization error by means of a time  
unit which is the time difference between two successive  
bits of a signal and which is referred to as the bit  
period. It appears that the available prior art  
20 solutions cannot achieve synchronization to an accuracy  
much better than one bit period.

This accuracy can prove insufficient in some cases.  
This is because synchronization gives the transit time of  
the signal in the transmission channel, in other words  
25 the transmission time between the transmitter and the  
receiver. This data is important in a duplex  
radiocommunications system in which a base station  
communicates with a terminal because the base station and  
the terminal have respective transceivers and the  
30 terminal must operate in such a way that the signal it  
transmits arrives at a precise time with reference to the  
clock of the base station. To achieve this, it is  
naturally necessary for the terminal to know the time  
taken for the signal to reach the base station.

35 The transmission time is also a direct reflection of  
the distance between the transmitter and the receiver.  
Clearly, the accuracy of this distance is of fundamental



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importance when it is a question of locating the terminal by identifying its position relative to one or more base stations. The general problem of locating a terminal is a very current concern because of its applications, which  
 5 include cell handover strategies in cellular networks, for example. The security field should also be mentioned, whether in connection with identifying the geographical location of the source of an emergency call or the position of a stolen vehicle equipped with the  
 10 terminal.

An object of the present invention is a synchronization method whose accuracy is much better than one bit period.

In accordance with the invention, the method of fine  
 15 synchronization to a receive signal corresponding to a reference signal transmitted in a transmission channel includes the following steps:

- selecting a source signal producing a characterization signal after it has passed through said transmission  
 20 channel,
- establishing a characterization matrix for estimating the covariance of the characterization signal,
- identifying dominant eigenvalues which are the highest eigenvalues of the characterization matrix,
- 25 - calculating the correlation function of the source signal with the sum of the eigenvectors associated with the dominant eigenvalues, and
- searching for the first maximum of the correlation function.

30 If the time increment adopted for calculating the correlation function is made sufficiently small, and in all cases much less than one bit period, the above method achieves very good accuracy.

A first option is for the number of dominant  
 35 eigenvalues to be predetermined. This number typically represents 20% to 30% of the dimension of the characterization matrix.

A second option is for the ratio of the sum of the dominant eigenvalues to the sum of the all the eigenvalues to be greater than or equal to a predetermined percentage. In this case the percentage  
 5 adopted is often greater than 90%, for example 95%.

A third option is for the method also to include a step of estimating the additive noise in the transmission channel, the dominant eigenvalues being such that their sum is less than or equal to the sum of all the  
 10 eigenvalues less the additive noise.

Also, the additive noise is estimated by normalizing the instantaneous noise, which is evaluated from the receive signal, the reference signal and an estimate of the impulse response of the transmission channel.  
 15

The expression for the instantaneous noise is advantageously:  $N_0 = S - A.X$ , where A is the transmission matrix associated with the reference signal.

Whichever of the above options is adopted, the characterization matrix results from a smoothing  
 20 operation.

In a preferred embodiment, the characterization signal is an estimate of the impulse response of the transmission channel.

The characterization signal can instead be the  
 25 receive signal.

The present invention emerges in more detail from the following description of proposed embodiments of the invention, which is given by way of illustrative example and with reference to the accompanying figures, in which:

- 30 - Figure 1 shows a first variant of the invention, and  
 - Figure 2 shows a second variant.

Elements common to both figures are allocated the same reference numbers.

The receiver has already achieved coarse  
 35 synchronization to the receive signal, to an accuracy of the order of one bit period, using any of the available prior art solutions.

The receive signal corresponds to a reference signal produced by the transmitter and known to the receiver. The reference signal can be known *a priori*, i.e. it can be a training sequence made up of identified symbols. It  
5 can also be determined *a posteriori* using techniques referred to generically as blind probing. In this case, during the synchronization procedure, the receiver regenerates from the receive signal the series of symbols forming the reference signal.

10 It is first necessary to characterize transmission between the transmitter and the receiver. To this end, a source signal produced by the transmitter is selected which yields a characterization signal in the receiver after transmission over the channel.

15 Of course, if the source signal is the reference signal, the characterization signal is the receive signal itself. This is not always the optimum solution, however, in terms of the complexity and performance of the method of the invention.

20 Another solution is to retain a modulated pulse as the source signal, in which case the characterization signal is the impulse response of the transmission channel.

For example, the GSM digital cellular mobile  
25 telephone system uses a training sequence made up of 26 symbols, the impulse response being generally estimated with five coefficients since it is accepted that the dispersion of the channel is equal to 4.

In this case, the receive signal has a maximum  
30 dimension of 22, which is significantly larger than that of the impulse response.

Two embodiments of the invention are therefore examined in succession and with reference to Figure 1, starting with the situation in which the source signal is  
35 a modulated pulse.

Estimating the impulse response does not give rise to any problems in itself because many methods are

available for this, for example the least squares method, which is described in particular in patent applications FR 2 696 604 and EP 0 564 849. Briefly, that technique uses a measurement matrix A constructed from the training sequence TS of length  $\underline{n}$ . The matrix A has  $(n-d)$  rows and  $(d+1)$  columns, where  $\underline{d}$  represents the dispersion of the channel. The element in the  $i$ th row and the  $j$ th column is the  $(d+i-j)$ th symbol of the training sequence.  $a_i$  denotes the  $i$ th symbol of a sequence TS of 26 symbols:

$$\begin{array}{r}
 a_4 \ a_3 \ a_2 \ a_1 \ a_0 \\
 a_5 \ a_4 \ a_3 \ a_2 \ a_1 \\
 a_6 \ a_5 \ a_4 \ a_3 \ a_2 \\
 A = a_7 \ \dots\dots\dots \\
 \dots\dots\dots \\
 \dots\dots\dots \\
 a_{25} \ \dots\dots\dots a_{21}
 \end{array}$$

The training sequence is chosen so that the matrix  $A^t A$  can be inverted, where the operator  $.^t$  represents transposition.

In the receive signal S, the first four symbols  $s_0$  to  $s_3$  are ignored because, given that the dispersion of the channel is 4, they also depend on the unknown symbol transmitted before the training sequence. The receive signal is defined hereinafter as a vector S having for its components the received symbols  $s_4, s_5, s_6, \dots, s_{25}$ .

The estimated impulse response X therefore takes the form:

$$X = (A^t A)^{-1} A^t . S$$

The next step of the method of the invention is to establish a statistic of this impulse response, where "statistic" means a data set reflecting the average value of the impulse response over an analysis period.

A matrix is therefore constructed for smoothing the various estimates X obtained during the analysis period to obtain an estimate of the covariance associated with

the impulse response. In this context the term "smoothing" is to be understood very broadly, i.e. as referring to any operation for smoothing or averaging the impulse response over the analysis period.

- 5 A first example of smoothing entails calculating the average of the matrix  $XX^h$  over the analysis period, which is assumed to include  $m$  training sequences:

$$L(XX^h) = \frac{1}{m} \sum_{i=1}^m XX^h$$

10

The operator  $\cdot^h$  represents the Hermitian transformation or complex conjugate transpose.

- A second example of smoothing entails, after the  $i$ th training sequence is received, updating the smoothing matrix  $L_{i-1}(XX^h)$  obtained on the  $(i-1)$ th training sequence by means of multiplier coefficient  $\alpha$ , this factor generally being known as the smoothing forget factor and ranging from 0 to 1:

$$L_i(XX^h) = \alpha X_i X_i^h + (1-\alpha) L_{i-1}(XX^h)$$

20

Any means can be used for this initialization, including the first estimate  $X$  obtained, or an average obtained as described for a small number of training sequences.

- For simplicity, the smoothing matrix  $L(XX^h)$ , which is in fact a statistical characterization matrix, is denoted  $L$  below.

The method then includes a step of looking for (eigenvalue, eigenvector) pairs of the characterization matrix.

- 30 This step is not described in more detail because it is well-known to the skilled person.

- The eigenvalues  $\lambda_i$  are then classified in decreasing order. Their sum corresponds to the energy of the characterization signal  $X$  made up in part of a wanted signal which images the source signal and in part of the additive noise  $N$  of the transmission channel.

- 35 The dominant eigenvalues, the ones which are the



highest, represent the wanted signal, whereas the lowest eigenvalues represent noise.

A first option is to retain a predetermined number of dominant eigenvalues. For example, the first two  
 5 eigenvalues  $\lambda_1$  and  $\lambda_2$  are retained for an impulse response with five coefficients.

A second option is to consider the wanted signal to have an energy which is a predetermined fraction  $\underline{f}$  of the energy of the characterization signal. Thus using the  
 10 notation  $\lambda_i$  for the eigenvalues with  $i$  varying from 1 to  $p$ , there will be  $\underline{d}$  dominant eigenvalues, where  $\underline{d}$  is obtained as follows:

$$\frac{\sum_{i=1}^d \lambda_i}{\sum_{i=1}^p \lambda_i} \leq f \quad \text{and} \quad \frac{\sum_{i=1}^{d+1} \lambda_i}{\sum_{i=1}^p \lambda_i} > f$$

15

The fraction  $\underline{f}$  can be fixed *a priori*, for example at 95%. This fraction can also be derived from the signal-to-noise ratio of the receive signal obtained elsewhere.

A third option, and doubtless that offering the best  
 20 performance, is for the additive noise  $N$  to be estimated directly from the receive signal and from the measurement matrix  $A$ . If  $N_0$  denotes the noise vector affecting the receive signal:

$$S = AX + N_0$$

25 Given that the vectors  $S$  and  $N_0$  have 22 components, the additive noise  $N$  can be expressed as follows:

$$N = \left(\frac{1}{22}\right)(S - AX)^h (S - AX)$$

30 This estimate of the additive noise can naturally be averaged and smoothed.

Using the previous notation, and standardizing the energies:

$$\sum_{i=d}^p \lambda_i \geq N \quad \text{and} \quad \sum_{i=d+1}^p \lambda_i < N$$

Thus the dominant eigenvalues are obtained from a direct estimate of the noise.

5        Whatever option is previously adopted, the next step of the method consists of calculating the correlation function of the source signal with the sum of the eigenvectors  $v_i$  associated with the dominant eigenvalues  $\lambda_i$ .

10        The source signal is oversampled relative to the bit period and is therefore denoted  $g(t)$  where  $t$  represents time and is a discrete variable whose quantization increment is 1/32 bit period, for example. It is represented by a vector with the same number of  
15        dimensions as the characterization signal, i.e. five dimensions in this example. The correction function  $c(t)$  is calculated for  $t$  varying from -1 to +1 bit period, for example, using the following expression:

20        
$$c(t) = \sum_{i=1}^d g(t) \cdot v_i$$

The period between the source signal  $g(t)$  and the eigenvector  $v_i$  represents a scalar product, in the conventional way.

25        The final step of the method looks for the value  $t_0$  of  $t$  that is closest to zero, which corresponds to the first relative maximum of the correlation  $c(t)$ . It is this particular value  $t_0$  which gives the required synchronization error relative to the reception signal.

30        The following complementary function  $c'(t)$  can also be considered:

$$c'(t) = \sum_{i=d+1}^p g(t) \cdot v_i$$

35        Note that the particular value  $t_0$  mentioned above can also be obtained by seeking the value of  $t$  closest to

zero, which corresponds to the first relative minimum of the complementary formation  $c'(t)$ .

These two methods of obtaining the synchronization  $t_0$  are therefore equivalent.

5       Turning to Figure 2, a second embodiment of the invention is considered in which the characterization signal is the receive signal  $S$ , so that the source signal is now the reference signal, or, in the case of the GSM, the training sequence  $TS$  when it is GMSK (Gaussian  
10       minimum shift keying) modulated.

The statistic of the characterization signal is therefore estimated by means of a characterization matrix which is now obtained by smoothing the various  
15       occurrences of the receive signal  $S$ . Once again, the term "smoothing" is to be understood in a very broad sense in this context.

The characterization matrix  $L$  therefore takes the following form:

20                               
$$L(SS^h) = \frac{1}{m} \sum_1^m SS^h$$

or

$$L_i(SS^h) = \alpha S_i S_i^h + (1-\alpha) L_{i-1}(SS^h)$$

25       The  $p'$  eigenvalues  $\lambda'_i$  of the matrix are then looked for, and as in the first embodiment the  $d'$  dominant eigenvalues are identified.

The correlation function  $f(t)$  of the modulated training sequence and the sum of the eigenvectors  $v'_i$  associated with the dominant eigenvalues  $\lambda'_i$  are now  
30       calculated.

Once again, the training sequence  $g'(t)$  is oversampled and is represented by a vector with 22 components. The correlation function therefore becomes:

35                               
$$f(t) = \sum_{i=1}^{d'} g'(t) \cdot v'_i$$

As before, a new complementary function  $f'(t)$  can be

defined:

$$f(t) = \sum_{i=d'+1}^{p'} g'(t).v'_i$$

5           The method terminates in the same manner by seeking the first maximum of the correlation function  $f(t)$  or the first minimum of the complementary function  $f'(t)$ .

          The invention can therefore be implemented in various ways, the essential point being to have access to  
10 a source signal and of the result of transmitting it, i.e. the characterization signal.

## CLAIMS

1. A method of fine synchronization to a receive signal (S) corresponding to a reference signal (TS) transmitted in a transmission channel, characterized in that it includes the following steps:
  - selecting a source signal producing a characterization signal (X, S) after it has passed through said transmission channel,
  - establishing a characterization matrix (L) for
  - 10 estimating the covariance of said characterization signal (X, S),
  - identifying dominant eigenvalues which are the highest eigenvalues ( $\lambda_i$ ,  $\lambda'_i$ ) of the characterization matrix (L),
  - calculating the correlation function (c(t), f(t)) of
  - 15 said source signal with the sum of the eigenvectors ( $v_i$ ,  $v'_i$ ) associated with said dominant eigenvalues, and
  - searching for the first maximum of the correlation function (c(t), f(t)).
2. A method according to claim 1, characterized in that
- 20 the number (d, d') of dominant eigenvalues ( $\lambda_i$ ,  $\lambda'_i$ ) is predetermined.
3. A method according to claim 1, characterized in that the ratio of the sum of said dominant eigenvalues to the sum of all the eigenvalues is greater than or equal to a
- 25 predetermined number.
4. A method according to claim 1, further including a step of estimating the additive noise (N) in the transmission channel, characterized in that said dominant eigenvalues are such that their sum is less than or equal
- 30 to the sum of all the eigenvalues less said additive noise (N).
5. A method according to claim 4, characterized in that the additive noise (N) is estimated by normalizing the

instantaneous noise ( $N_0$ ) which is evaluated by means of said receive signal (S), said reference signal (TS) and an estimate of the impulse response (X) of the transmission channel.

- 5 6. A method according to claim 5, characterized in that the expression for the instantaneous noise ( $N_0$ ) is

$$N_0 = S - A.X$$

where A denotes the transmission matrix associated with said reference signal (TS).

- 10 7. A method according to claim 6, characterized in that said additive noise (N) is also averaged.

8. A method according to any of claims 1 to 7, characterized in that said characterization matrix (L) is the result of a smoothing operation.

- 15 9. A method according to any preceding claim, characterized in that said characterization signal is an estimate of the impulse response (X) of the transmission channel.

10. A method according to any of claims 1 to 8,  
20 characterized in that said characterization signal is said receive signal (S).

## A B S T R A C T

METHOD OF FINE SYNCHRONIZATION TO A SIGNAL RECEIVED FROM  
A TRANSMISSION CHANNEL

5

The invention relates to a method of fine synchronization to a receive signal (S) corresponding to a reference signal (TS) transmitted in a transmission channel. The method includes the following steps:

- 10 - selecting a source signal producing a characterization signal (X) after it has passed through said transmission channel,
- establishing a characterization matrix (L) for estimating the covariance of the characterization signal
- 15 (X),
- identifying dominant eigenvalues which are the highest eigenvalues ( $\lambda_i$ ) of the characterization matrix (L),
- calculating the correlation function  $c(t)$  of the source signal with the sum of the eigenvectors ( $v_i$ ) associated
- 20 with the dominant eigenvalues, and
- searching for the first maximum of the correlation function  $c(t)$ .

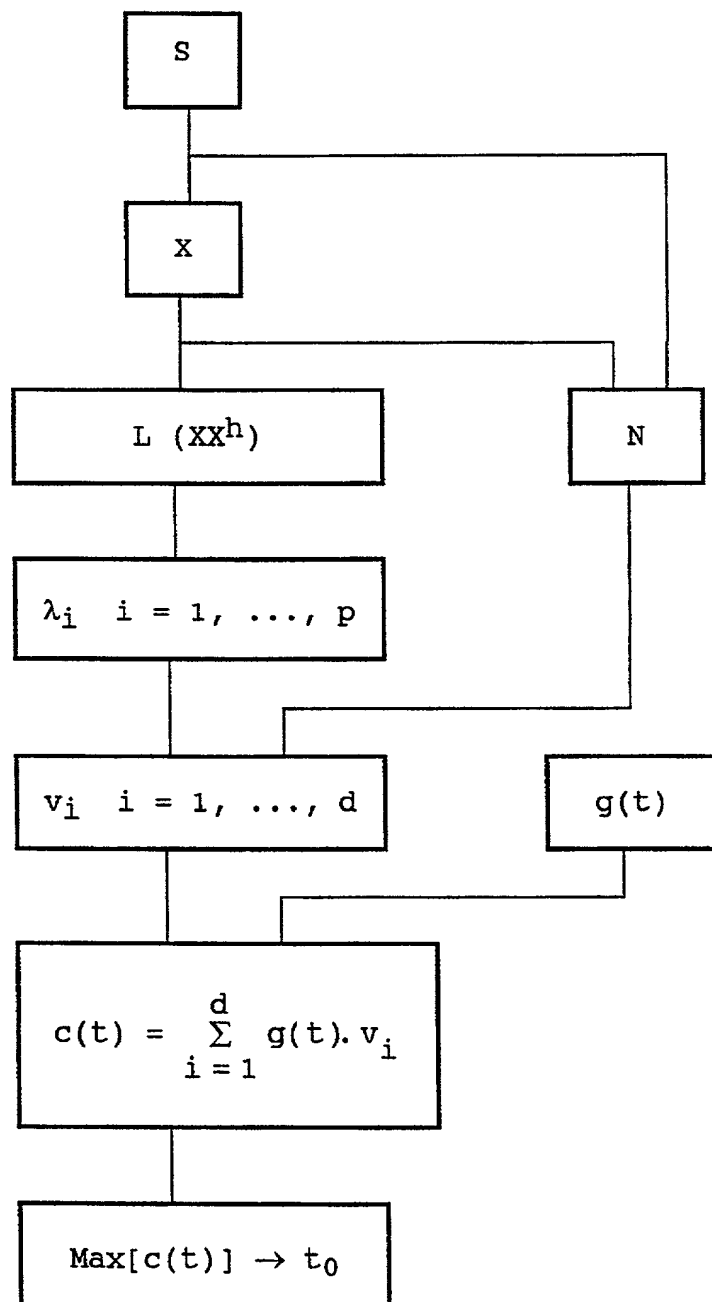
25

30

Translation of the title and the abstract as they were when originally filed by the

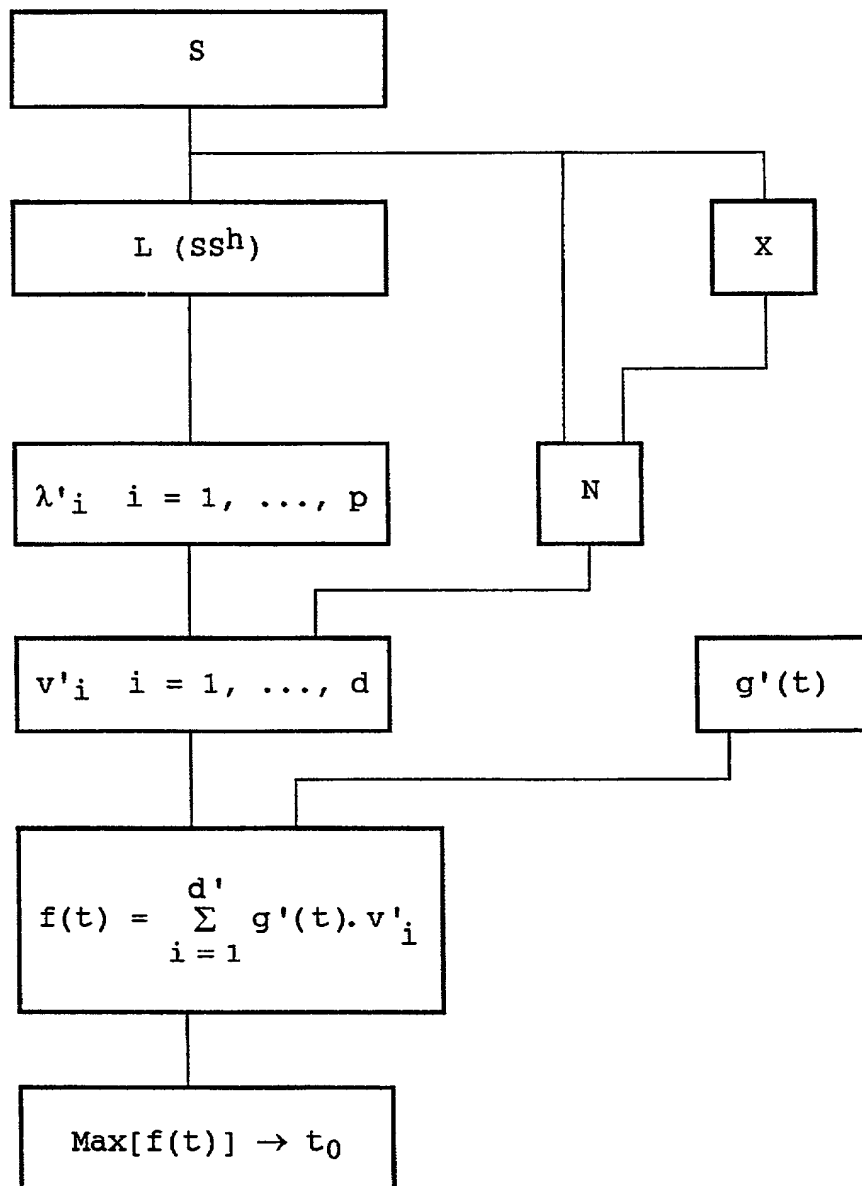
35 Applicant. No account has been taken of any changes that may have been made subsequently by the PCT Authorities acting ex officio, e.g. under PCT Rules 37.2, 38.2, and/or 48.3.

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DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated  
below next to my name.



I believe I am the original, first and sole inventor (if only one name is listed below) or an  
original, first and joint inventor (if plural names are listed below) of the subject matter which is  
claimed and for which a patent is sought on the invention entitled Procédé de Synchronisation

*fine* Sur Un Signal Reçu D'un Canal de Transmission, the specification of which:

— is attached hereto.

x was filed on April 9, 1999 as

Application Serial No. \_\_\_\_\_

and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified  
specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this  
application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any  
foreign application(s) for patent or inventor's certificate listed below and have also identified  
below any foreign application for patent or inventor's certificate having a filing date before that  
of the application on which priority is claimed:

McWilliams, Sweeney & Ohlson, P.O. Box 2786, Chicago, Illinois 60690-2786, telephone number (312) 368-1300.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: Jean-Louis DORNSTETTER

Signature [Signature] Date October 30<sup>th</sup> 2000

Country of Residence: FRANCE JRX

Country of Citizenship: FRANCE

Post Office and Residence Address: Grande de la grange aux Moines - 78460 Phais

Full name of joint inventor: Nidham BEN RACHED

Signature [Signature] Date 30 oct. 2000

Country of Residence: FRANCE JRX

Country of Citizenship: TUNISIA

Post Office and Residence Address: 32, rue Beron  
75017 Paris

Full name of joint inventor: \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

Country of Residence: \_\_\_\_\_

Country of Citizenship: \_\_\_\_\_

Post Office and Residence Address: \_\_\_\_\_

# PRIOR FOREIGN APPLICATION(S)

<u>Country</u>	<u>Number</u>	<u>Date Filed</u>	<u>Priority Claimed</u>	
			<u>Yes</u>	<u>No</u>
<u>FRANCE</u>	<u>98 04 782</u>	<u>April 10, 1998</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

I hereby claim the benefit under Title 35, United States Code Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

<u>Application Serial No.</u>	<u>Filing Date</u>	<u>Status</u>
_____	_____	_____
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And I hereby appoint Wm. Marshall Lee, Registration No. 16,853, John M. Mann, Registration No. 17,775, Thomas E. Smith, Registration No. 18,243, Dennis M. McWilliams, Registration No. 25,195, James R. Sweeney, Registration No. 18,721, William M. Lee, Jr., Registration No. 26,935, Glenn W. Ohlson, Registration No. 28,455, David C. Brezina, Registration No. 34,128, Jeffrey R. Gray, Registration No. 33,391, Timothy J. Engling, Registration No. 39,970, Gregory B. Beggs, Registration No. 19,286 and Gerald S. Geren, Registration No. 24,528 as my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith. It is requested that all communications be directed to Lee, Mann, Smith,

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